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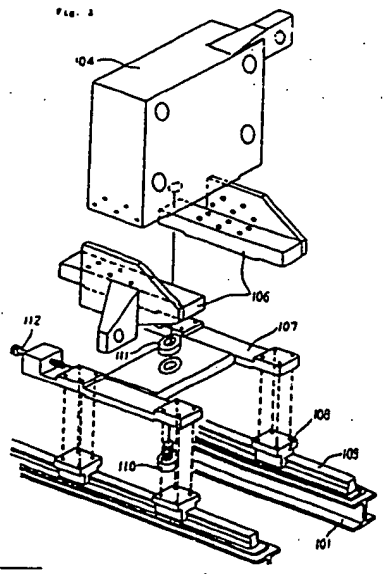
(54) Die clamping apparatus.

(57) A die clamping apparatus consisting of a fixed die plate (10, 21) for holding a fixed die (103), a movable die plate (104, 6) for holding a movable die (105), means (114) for actuating the movable die plate to advance or retreat with respect to the fixed die plate, and tie bars for performing die clamping as fixedly coupled to the fixed die plate (102, 1) after the movable die plate (104, 6) has approached to the fixed die plate and the fixed die and the movable die have closed a mold, is improved. The improvements reside in that a movable die plate (104, 6) main body and advance/retreat operation guide means (109) on which the movable die plate (104, 6) is placed are separately formed and they are pin (110)-coupled so as to be mutually rotatable.



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DIE CLAMPING APPARATUS

BACKGROUND OF THE INVENTION:

Field of the Invention:

The present invention relates to a die clamping apparatus that is applicable to an injection molding machine, a press machine, a die casting machine, etc.

Description of the Prior Art:

One example of a die clamping apparatus in the prior art is shown in Figs. 16 to 19.

In these figures, reference numeral 1 designates a fixed die plate, numeral 2 designates tie bars, numeral 3 designates a fastening side fixed panel, numeral 4 designates a die clamping cylinder, numeral 5 designates a base, numeral 6 designates a movable die plate, and as a result of actuation of the die clamping cylinder 4 the movable die plate 6 moves on the base 5. The movable die plate 6 has the configuration shown in the figures, and it is supported from liners 20 laid on the base 5 via rollers 7 provided at its botton without being suspended by the tie bars 2.

In addition, in the lower portion of the movable die plate 6 is formed a recess 8 having a bottom surface inclined in the direction of movement as shown in Fig. 18, and in this recess 8 is fitted an adjustor block 9 carrying the above-mentioned rollers 7 and provided with an inclined surface having the same gradient as the aforementioned bottom surface so as to be held in contact therewith, with an appropriate gap space retained between the adjustor block 9 and the opposite end protrusions of the same recess 8. Furthermore, on the opposite end surfaces of the adjustor block are provided adjusting bolt 10 and 11 respectively penetrating through the opposite end protrusions of the recess, so that the position of the adjustor block 9 is determined by these bolts 10 and 11, and as a result, the height of the movable die plate 6 is finely adjusted. Reference numerals 12 and 13 designate adjusting nuts respectively mated with the bolts 10 and 11.

On the other hand, on the opposite side surfaces of the lower portion of the movable die plate 6 are disposed adjustor blocks 14 and 15, respectively, which are mounted to the side surfaces via mutually inclined contact surfaces as best seen in Fig. 19, and guide rollers 16 and 17 rotatably supported by these adjustor blocks 14 and 15, respectively, are held in contact with guide plates 18 and 19, respectively, which are laid on the base 5 in parallel to the tie bars 2. Accordingly, the position in the lateral direction of the movable die plate 6 can be finely adjusted by moving the adjustor block 14 and 15 in the back or forth direction. The movable die plate 6 which has been positioned in the vertical direction and in the lateral direction in the above-described manner, is moved on the base 5 by the actuation of the die clamping cylinder 4.

The heretofore known die clamping apparatuses one example of which has been described above, generally involved the following problems to be resolved:

(1) Generally, in the case of making a movable die plate advance or retreat as guided by rollers, as seen in Figs. 16 to 19, besides the rollers 7 provided at the bottom of the movable die plate 6, normally the guide rollers 16 and 17 are further necessitated on the opposite side surfaces of the movable die plate 6 for the purpose of preventing zig-zag motion during travelling, and adjusting parallelism between the fixed die plate 1 and the movable die plate 6. Accordingly, a large number of parts are necessitated in the guide mechanism, and there is a tendency that the guide mechanism would be large-sized.

The above-described apparatus shown in Figs. 16 to 19 includes one example of such large-sized guide mechanism in the prior art, in which a guide action for moving the movable die plate 6 in parallel to the plane of the floor is effected by the rollers 7, and restraint of movement within the horizontal plane (prevention of zig-zag motion) is effected by the guide rollers 16 and 17.

(2) On the other hand, whether or not the movable die plate 6 can perform advance and retreat operations smoothly and precisely, is dependent upon an operational precision of the die clamping cylinder 4 for moving the movable die plate 6, and in the event that vibration in the vertical direction (rising) of the movable die plate caused by stick-slip and breathing phenomena of the die clamping cylinder 4 is feared, in addition to the above-mentioned guides, an other guide for restraining such vibration is further necessitated, and thus the guide mechanism would be more and more complicated and large-sized.

SUMMARY OF THE INVENTION:

The present invention has been worked out in view of the above-described technical background, and it is one object of the present invention to provide a die clamping apparatus which employs a guide mechanism having a simple structure and yet capable of restraining simultaneously in the vertical direction and in the lateral direction, and which can finely adjust the die planes in parallel through a relatively simple operation.

In order to achieve the above-mentioned object, according to one feature of the present invention, in a die clamping apparatus consisting of a fixed die plate for holding a fixed die, a movable die plate for holding a movable die, means for actuating the movable die plate to advance or retreat with respect to the fixed die plate, and tie bars for performing die clamping as fixedly coupled to the fixed die plate after the movable die plate has approached to the fixed die plate and the fixed die and the movable die have closed a mold, a movable die plate main body and advance/retreat operation guide means on which the movable die plate is placed are separately formed, and they are pin-coupled either nearly at the center or at four locations on the back and forth and on the left and right so as to be mutually rotatable.

According to another feature of the present invention, in the above-featured die clamping apparatus, the advance/retreat operation guide is provided with stopper bolts on the left and right of its advance/retreat directions, and rotation of the movable die plate is made adjustable by adjustment of the screwing strokes of the respective stopper bolts.

According to the present invention, owing to the above-mentioned structural features the following advantages can be attained:

(1) Owing to the fact that the guide means and the movable die plate are formed separately and they are pin-coupled either nearly at the center or at four locations on the back and forth and on the left and right of the movable die plate, it is possible that only the movable die plate is rotated independently of the guide means and thereby fine adjustment of parallelism between the movable die plate and the fixed die plate is achieved relatively easily.

(2) By manipulating the left and right stopper bolts of the advance/retreat operation guide means to adjust the screwing strokes of the stopper bolts, rotation of the movable die plate with respect to the advance/retreat operation guide means is effected easily, and the adjustment of the movable die plate can be achieved precisely.

(3) In the case where the movable die plate and the guide means are pin-coupled nearly at the center of the movable die plate, during normal operation the movable die plate and the guide means are operated integrally via the joint pin, but during unsteady operation such as when abrupt speed change arises, for instance, upon emergency stoppage or uneven load to the left and right guide members with respect to the travelling direction is generated, or when a large load or moment is applied to the movable die plate upon die clamping or the like, deformation and forces on the side of the movable die plate would not be directly transmitted to the guide means, and the entire load would not act upon the guide means.

(4) Furthermore, in response to a load in the horizontal direction also, the contact planes of the movable die plates and the guide means would displace relatively, and hence such an excessive force as exceeding a loading capability of the guide means would not be exerted upon the guide means.

The above-mentioned and other objects, features and advantages of the present invention will become more apparent by reference to the following description of preferred embodiments of the invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS:

In the accompanying drawings:

Fig. 1 is a perspective view of an entire die clamping apparatus showing a first preferred embodiment of the present invention;

Fig. 2 is a disintegrated perspective view of a movable die plate and a guide mechanism in Fig. 1;

Fig. 3 is a top view of the same;

Fig. 4 is a cross-section view taken along line A-A in Fig. 3;

Fig. 5 is a top view showing a responded state of a guide mechanism upon deformation of a movable die plate;

Fig. 6 is a cross-section taken along line B-B in Fig. 5;

Fig. 7 is a detailed cross-section view showing one practical example of a hydraulic cylinder that can be employed according to the present invention;

Fig. 8 is a perspective view of an entire die clamping apparatus showing a second preferred embodiment of the present invention;

Fig. 9 is a disintegrated perspective view of a movable die plate and a guide mechanism in Fig. 8;

Fig. 10 is a plan view of the movable die plate and the guide mechanism in Fig. 8;

Fig. 11 is a side view as viewed in the direction of arrow C in Fig. 10;

Fig. 12 is a plan view showing the movable die plate in a deformed (warped) state as compared to the state shown in Fig. 10;

Fig. 13 is a side view as viewed in the direction of arrow d in Fig. 12;

Fig. 14 is a schematic view showing rotation of the movable die plate by means of the push bolts in Fig. 12 (adjustment for parallelism between die mounting planes);

Fig. 15 is a side view partly in cross-section showing a coupling condition between a screw and a nut in Fig. 8;

Fig. 16 is a side view of a die clamping apparatus in the prior art;

Fig. 17 is a cross-section view taken along line E-E in Fig. 16;

Fig. 18 is an enlarged cross-section view showing a roller portion in Fig. 16; and

Fig. 19 is an enlarged side view of a guide roller portion in Fig. 17.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Referring now to Figs. 1 and 2 which show the first preferred embodiment of the present invention, reference numeral 101 designates a base, and at one end of the base 101 is fixedly secured a fixed die plate 102. On the other hand, at the bottom portion of a movable die plate 104, supports 106 elongated in the direction of travelling so as to stably support the center of gravity of the movable die plate 104 are mounted to the left and right lower side portions of the movable die plate 104, and the assembly is placed on the base 101 via a guide mounting plate 107, guide blocks 108 and guide rails 109 so as to be movable in the back and forth directions.

To the opposed surfaces of the fixed die plate 102 and the movable die plate 104 are mounted a fixed die 103 and a movable die 105, respectively.

The basic structure of the support 106 consists of a rectangular bottom plate having steps on its lower surface and a side plate fixedly secured to one side surface there of as shown in Fig. 2, and in order to support the movable die plate 104 in a self-standing state the supports 106 are fixedly secured to the left and right lower side surfaces of the bottom portion of the movable die plate 104 as described above.

The above-mentioned guide mounting plate 107 has the structure shown in Fig. 2, that is, generally it has a H-shaped configulation in plan, on the upper surfaces of the respective leg portions are formed steps corresponding to the steps formed on the lower surfaces of the above-mentioned supports 106, so that the lower surfaces of the supports 106 are placed on these upper surfaces of the leg portions, and guide blocks 108 are mounted to the lower surfaces at the four corners of the guide mounting plate 107. The above-described guide mounting plate 107 has a small rigidity as compared to the support 106.

The guide blocks 108 are placed on the guide rails 109, and they are formed as linear motion type guides which can be restrained in the vertical direction as well as the horizontal direction in their advance/retreat operations.

Reference numeral 110 designates a center pin which connects the nearly central portion of the above- mentioned guide mounting plate 107 and the nearly central portion of the bottom surface of the movable die plate 104 with a spacer 111 interposed therebetween. As shown in Fig. 6, this center pin 110 penetrates a through-hole formed nearly at the center of the guide mounting plate 107 and having a somewhat larger inner diameter than the outer diameter of the center pin 110, and is threadedly engaged with the movable die plate 104. Furthermore, to the left and right rear ends of the guide mounting plate 107 are mounted stopper bolts 112, 112, and they are arranged that the screwed tip ends of the stopper bolts 112 may butt against the leg portions of the movable die plate 104.

The guide rails 109 are fixedly secured to the left and right upper surfaces of the base 101, to form guide surfaces for the advance/retreat operation of the movable die plate 104.

Reference numeral 113 designates tie bars, which are fixedly secured to the movable die plate 104 as penetrating therethrough by means of nuts 124, and at the tip end portions of these tie bars 113 are formed screw threads 117 to be meshed with half-nuts 140 as will be described later.

Between the fixed die plate 102 and the movable die plate 104 are mounted mold opening/closing cylinders 114 so as to move the movable die plate 104 back and forth.

Now description will be made on a die clamping pressure booster mechanism used in the illustrated embodiment.

Fig. 7 shows this pressure booster mechanism, in which a hydraulic cylinder 121 is contained within each of the portions of the fixed die plate 102 opposed to the tie bars 113, and upon boosting the die clamping pressure, by feeding pressurized oil to an oil chamber 122A a ram 120 of the hydraulic cylinder 121 is moved rightwards as viewed in Fig. 7, and at its tip end portion 120a the

ram 120 pushes the half nut 140 which has been already held in a meshed condition with the screw threads 117 of the tie bar and which will be described later, and thereby generates a die clamping force.

The ram 120 has a hollow structure and forms a tie bar penetrating hole 130 by its inner diameter portion, and upon clamping dies, the tie bar 113 extends through this penetrating hole 130 and has its screw threads 117 meshed with the half nut 140.

The half nut 140 is a nut divided into two halves on the left and right, which is provided on the backside of the fixed die plate 102 and is adapted to be closed by an opening/closing mechanism not shown to be meshed with the screw threads 117 of the tie bar and thus generates a die clamping force as pushed by the ram 120, upon clamping dies.

Now the operation of the above-described construction will be explained.

When pressurized oil is fed into the rod-side oil chamber in the mold opening/closing cylinder 114, the movable die plate 104 travels towards the fixed die plate 102 as guided by the guide rails 109, the tip end of the tie bar 113 passes through the tie bar penetrating hole 130 in the fixed die plate 102, and the movable die plate 104 stops at the position where the fixed die 103 and the movable die 105 have jointed together.

The half nut 140 disposed on the backside of the fixed die plate 102 is moved by a minute amount for adjustment in the direction of travelling of the tie bar in correspondence to the thickness of the dies, and thus it is positioned by an adjusting device not shown up to the position where it can be meshed with the screw threads 117 of the tie bar.

Simultaneously with the joining of the dies, the left and right half nut pieces 140A and 140B are closed by the opening/closing device (not shown), subsequently by feeding pressurized oil into an oil chamber 122A on the left side as viewed in Fig. 7 of the ram 120, the ram 120 is moved rightwards as viewed in the same figure, and thus it pushes the half nut 140 rightwards with its tip end portion 120a and thereby generates a die clamping force.

When molding has finished and the mold is to be opened, the pressure in the left side oil chamber 122A is lowered, then the half nut 140 is opened by means of the opening/closing device therefor (not shown), and thereafter when pressurized oil is fed into the head side oil chamber of the mold opening/closing cylinder 114, the movable die plate 104 is moved leftwards in Fig. 7 to open the mold.

In a die clamping apparatus in an injection molding machine or the like which repeats the above-described operation, the movable die plate 104 is placed on the base 101, and it is connected to the fixed die plate 102 by the intermediary of one or more mold opening/closing cylinders 114 and performs die opening/closing operations, that is advance/retreat operations. In such an apparatus, the parallelism between the die mounting planes of the movable die plate 104 and the fixed die plate 102 is extremely important, and so, according to the present invention it is contemplated that the parallelism is adjusted by rotating the movable die plate 104 about the center pin 110 via the guide mounting plate 107 by changing screwing strokes of the left and right stopper bolts 112 which butt against the leg portion of the movable die plate 104.

Though the movable die plate 104 is connected with the mold opening/closing cylinder 114, the operation precision is determined by the structure of the guide mechanism for its leg portion. An abrupt speed change during operation of the movable die plate 104 including emergency stoppage would result in application of a forwardly or backwardly tilting force to the movable die plate 104, and upon clamping dies, a backwardly tilting force directed in the direction of pulling the movable die plate 104 towards the fixed die plate 102 is exerted upon the movable die plate 104 from the ram 120 via the tie bar 113. Furthermore, if the force generated by the mold opening/closing cylinder 114 is in such an unbalanced condition that it produces a torque, then there is a tendency that a force tending to cause zig-zag motion of the movable die plate 104 (a force directed in the horizontal direction) is applied to the guide mechanism.

If it is contemplated to directly bear these forces directed in the vertical direction and in the horizontal direction by the guide mechanism, then it is necessary that guide members are provided respectively for the upper and lower directions and for the left and right directions and a load bearing capability that can be adapted to every case is provided, and in this case it is inevitable that the guide mechanism is considerably large-sized and complicated.

In order to avoid such situation, according to the present invention, a guide mechanism of such construction that a load bearing capability both in the vertical direction and in the horizontal direction is provided, is employed.

In the illustrated embodiment, provision is made such that the movable die plate 104 and the guide mounting plate 107 are coupled only via the center pin 110, and the weight of the movable die plate 104, the movable die 105 and the like as well as the inertial force during movement of the movable die plate 104 are transmitted via the surface contact between the supports 106 and the guide mounting plate 107. (not directly coupled).

Accordingly, even in the illustrated embodiment, when the movable die plate 104 is moving in a steady state, the movable die plate 104 and the guide block 108 would smoothly advance and retreat as if they are integrally fixed together via the supports 106 and the guide mounting plate 107 as shown in Figs. 3 and 4.

However, in the event that a force tending to cause zig-zag motion of the movable die plate 104 acts upon the movable die plate 104 in the horizontal direction, the supports 106 would move in the lateral direction on the guide mounting plate 107 within the scope of the clearance about the center pin 110 in the through-hole, and thereby this force is prevented from acting upon the guide mechanism.

In addition, when a forwardly tilting force or a backwardly tilting force is exerted upon the movable die plate 104, owing to the fact that the movable die plate 104 and the guide mounting plate 107 are coupled via the pin 110, the front end portion or the rear end portion of the support 106 can deform in the direction of separating from the guide mounting plate 107 independently of the guide mounting plate 107, and so, the contact pressure between these members is reduced. Furthermore, since the rigidity of the guide mounting plate 107 is assumed to be small as described previously, the force generated by the deformation of the guide mounting plate 107 caused by the deformation of the support 106 is also small. Consequently, it can be prevented that an excessive force acts upon the guide mechanism due to the forwardly tilting force or the backwardly tilting force acted upon the movable die plate 104.

It is to be noted that in the above-described guide block 108, while a linear motion type bearing in which a plurality of rollers or balls are assembled (a rolling type bearing) is useful for assembling the block in a compact form, as a matter of course, a slide guide surface could be employed without any inconvenience.

A second preferred embodiment of the present invention is illustrated in Figs. 8 to 15, in which reference numeral 201 designates a base, numeral 202 designates a fixed die plate, and the fixed die plate 202 is fixedly secured to one end of the base 201 and has a fixed die 203 mounted thereon. Reference numeral 204 designates a movable die plate having a movable die 205 mounted thereon, to the leg portion of the movable die plate 204 are mounted supports 206 elongated in the direction of travelling on the left and right of the movable die plate 204 so as to stably support the center of gravity, and the supports 206 are placed on the base 201 via guide mounting plates 207, guide blocks 208 and guide rails 209. The supports 206 are fixedly secured to the left and right of the leg portion of the movabld die plate 204 in order to support the movable die plate 204. In addition, the guide mounting plate 207 has the guide block 208 mounted thereto. The guide block 208 is placed on the guide rail 209, hook-shaped projections at the bottom portion of the guide block 208 are engaged with grooves of the guide rail 209 directed in the lengthwise direction thereof, so that in the advance and retreat operations the guide block 208 and the guide rail 209 jointly form a linear motion type guide which can restrain motions both in the vertical direction and in the horizontal direction. The guide rails 209 are fixedly secured onto the left and right top surfaces of the base 201, and they serve as guide surfaces for advance and retreat operations of the movable die plate 204.

Reference numerals 210a and 210b designate connecting pins for interconnecting the guide mounting plates 207 with the support 206, and they are provided two on each side. The connecting pin 210a located on the left side as viewed in Fig. 8, that is, on the side farther from the fixed die 203, is fitted in the guide mounting plate 207 and the support 206 with a high precision of alignment, that is, the connecting pin 210a is fitted in these both members in such manner that relative movement in the horizontal direction between the guide mounting plate 207 and the support 206 may be small, whereas the other connecting pin 210b is somewhat loosely fitted in these both members in such manner that the relative movement in the horizontal direction between the guide mounting plate 207 and the support 206 may be large. Reference numeral 212 designates stopper bolts, which are respectively mounted to the tip end portions of the left and right supports 206 and serve as push bolts having their threaded tip end butted against the corresponding guide mounting plates 207. Reference numeral 213 designates tie bars which are fixedly secured to the movable die plate 204 by means of nuts 204, and at its free end portion are formed screw threads 217 to be meshed with a half nut 240. Reference numeral 215 designates a mold opening/closing cylinder that is mounted between the fixed die plate 202 and the movable die plate 204 and serves to make the movable die plate 204 advance and retreat. The screw threads 217 are adapted to be meshed with the half nut 240 disposed on the backside (the side opposite to the die mounting surface) of the fixed die plate 202, and provided at the tip end portion of the tie bar 213. Reference numeral 219 designates a hydraulic cylinder for boosting a die clamping pressure, that is contained within the fixed die plate 202, reference numeral 220 designates a ram which is moved rightwards as viewed in Fig. 15 by feeding pressurized oil into an oil chamber 222A upon boosting the die clamping pressure, and which pushes at its tip

portion 221 the half nut 240 that has been already held in a meshed condition with the screw threads 217 on the tie bar 213, to generate a die clamping force, and numeral 222B designates the other oil chamber in the hydraulic cylinder 219. Reference numeral 230 designates a tie bar penetrating hole which consists of an inner diameter portion of the ram 220, and which is the through-hole having the tie bar 213 penetrated therethrough in order to be meshed with the half nut 240 up on clamping the dies. The half nut 240 is a nut divided into two left and right pieces, that is, into left and right members 240A and 240B, which are closed by means of an opening/closing mechanism not shown up clamping the dies, and thus meshed with the screw threads 217 on the tie bar 213, and which generates a die clamping force as pushed by the ram 220.

Now operation will be made on the operation of the second preferred embodiment of the present invention constructed in the above-described manner. When pressurized oil is fed into a rod-side oil chamber in the mold opening/closing cylinder 215, the movable die plate 204 travels towards the fixed die plate 202 as guided by the guide rail 209, the tip end of the tie bar 213 passes through the tie bar penetrating hole 230 in the fixed die plate 202, and stops at the position where the fixed die 203 and the movable die 205 join together. At this moment, the half nut 240 provided on the backside of the fixed die plate 202 has been already adjusted in position by means of an adjusting device not shown, up to the position where it can be meshed with the screw threads 217 by adjustably moving the half nut 240 by a minute amount in the direction of travelling of the tie bar in correspondence to the thickness of the dies. When the dies have been joined in the above-described manner, the left and right members 240A and 240B of the half nut 240 are closed by means of an opening/closing device not shown, subsequently by feeding pressurized oil into the oil chamber 222A on the left side of the ram 220, the ram 220 is moved rightwards, and it pushes at its tip end portion 221 the above-mentioned half nut 240 rightwards and thereby generates a die clamping force.

When molding has been finished and the mold is to be opened, the oil pressure in the oil chamber on the left side of the ram 220 is lowered, then the half nut 240 is opened by means of the opening/closing device therefor (not shown), and thereafter when pressurized oil is fed into the head side oil chamber in the mold opening/closing cylinder 215, the movable die plate 204 moves leftwards and the mold is opened.

In a die clamping apparatus in an injection molding machine or the like which repeats the above-mentioned operation, the movable die plate 204 is placed on the base 201, and it is connected to the fixed die plate 202 by the intermediary of one or more mold opening/closing cylinders 215 and performs die opening/closing operations, that is, advance/retreat operations. In such an apparatus, the parallelism between the die mounting planes of the movable die plate 204 and the fixed die plate 202 is extremely important, and so, according to the present invention, this parallelism can be adjusted by rotating the movable die plate 204 by some amount as a result of relative displacement between the support 206 and the guide mounting plate 207, by changing the screwing strokes of the stopper bolts 212 provided at the tip ends of the left and right supports 206 fixed to the leg portion of the movable die plate 204.

More particularly, as specifically shown in Fig. 14, by fastening and loosening the left and right stopper bolts 212, respectively, or vice versa, the movable die plate 204 can be rotated by some amount. Fig. 14 shows the state where the stopper bolt 212 on the side depicted partly in cross-section has been fastened and the other stopper bolt 212 has been loosen (deformation from the state depicted by double-dot chain lines to the state depicted by solid lines), and initial pin-connected positions a, b, c and d are rotationally shifted to positions $\bar{a}$, $\bar{b}$, $\bar{c}$ and $\bar{d}$, respectively. At this time, the movements $a \rightarrow \bar{a}$ and $b \rightarrow \bar{b}$ of the connecting pins 210a on the respective sides almost consist of movements in the direction of X-axis only as compared to movements in the direction of Y-axis because the connecting pins 210a are fitted in the guide mounting plates 207 and the supports 206 with a high precision of alignment, and this means that the guide mounting plates 207 are merely displaced in the direction of X-axis jointly with the guide blocks 208 and there is no substantial displacement of the pin-connected positions. Whereas, in the movements $c \rightarrow \bar{c}$ and $d \rightarrow \bar{d}$ of the connecting pins 210b on the respective sides, since these connecting pins 210b are loosely fitted in the guide mounting plate 207 and the supports 206, larger movement is effected in the direction of Y-axis than in the direction of X-axis. As described above, it is necessary that the pin-connections at the points a and b are effected as highly precise fitting, but the pin-connections at the points c and d are effected as somewhat loose fitting so that they can be adapted to predetermined rotational adjustment.

Figs. 10 to 13 are schematic views to be referred to for explaining another effect of the stopper bolts 212. In the event that a torque tends to act upon the movable die plate 204 due to any operation, the tip ends of the two stopper bolts 212 would prevent this (Figs. 10 and 11). In addition, when deformation as shown in Figs. 12 and 13 was

applied to the movable die plate 204, relative displacement would arise between the supports 206 and the guide mounting plates 207, hence the tip ends of the stopper bolts 212 would separate from the guide mounting plates 207, and accordingly, it can be preliminarily avoided that a large load directed in the lateral direction is applied to the guide block 208. It is to be noted that while the above-described guide block 208 can be assembled in the most compact form if it is formed as a linear motion type bearing in which a plurality of sets of rollers or balls are assembled (a rolling type), as a matter of course, a sliding guide surface could be employed without any inconvenience.

As described in detail above, the present invention can provide the following effects and advantages:

(1) In the above-described guide mechanism, owing to the fact that the movable die plate and the guide mounting plate having the guide block mounted thereto are formed as separate bodies and then are pin-connected so as to be able to rotate relatively, the movable die plate can be adjusted so as to have parallelism with respect to the fixed die plate by rotating the movable die plate with respect to the guide mounting plate. In addition, an excessive load caused by an unsteady operation of the movable die plate, would not be directly applied to the guide, and so, a load capacity of the guide can be made small.

(2) Adjustment for parallelism between the movable die plate and the fixed die plate can be achieved relatively easily by means of the stopper bolts provided in the left and right guide sections.

While a principle of the present invention has been described above in connection to preferred embodiment of the invention, it is intended that all matter contained in the above description and illustrated in the accompanying drawings shall be interpreted to be illustrative and not in a limiting sense.

Claims

1. A die clamping apparatus consisting of a fixed die plate for holding a fixed die, a movable die plate for holding a movable die, means for actuating said movable die plate to advance or retreat with respect to the fixed die plate, and tie bars for performing die clamping as fixedly coupled to the fixed die plate after said movable die plate has approached to the fixed die plate and the fixed die and the movable die have closed a mold; characterized in that a movable die plate main body and advance/retreat operation guide means on which said movable die plate is placed are separately formed, and they are pin-coupled so as to be mutually rotatable.

2. A die clamping apparatus as claimed in Claim 1, characterized in that said movable die plate and the advance/retreat operation guide means are pin-coupled nearly at the center so as to be mutually rotatable.

3. A die clamping apparatus as claimed in Claim 1, characterized in that said advance/retreat operation guide means is disposed on the both sides of said movable die plate, and they are pin-coupled at four locations on the back and forth and on the left and right so that said guide means and said die plate can perform some rotation.

4. A die clamping apparatus as claimed in any one of Claims 1 to 3, characterized in that said advance/retreat operation guide means has stopper bolts on the left and right of its advance/retreat directions, and rotation of the movable die plate is made adjustable by adjustment of the screwing strokes of the respective stopper bolts.

Fig. 1

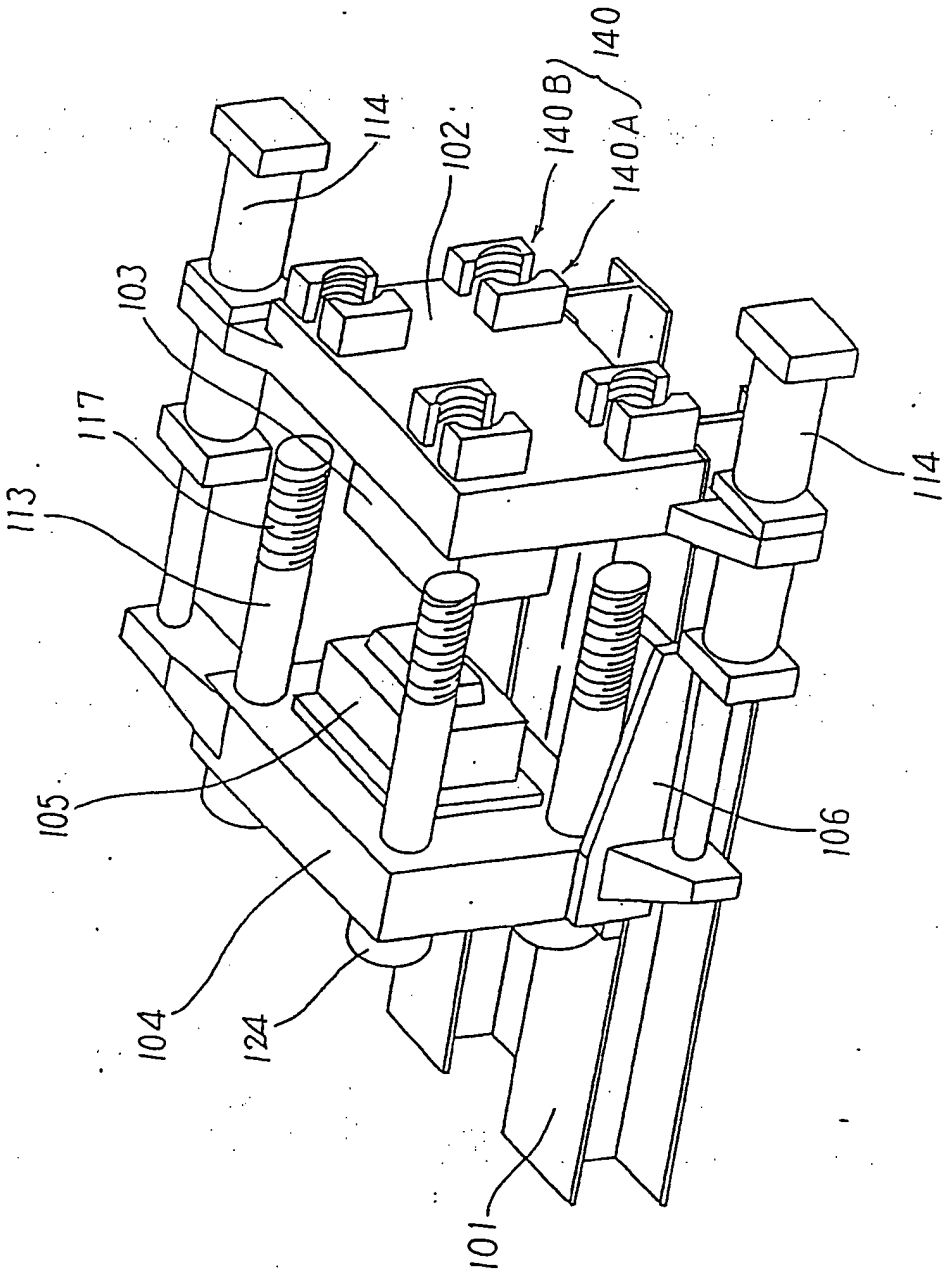

Fig. 2

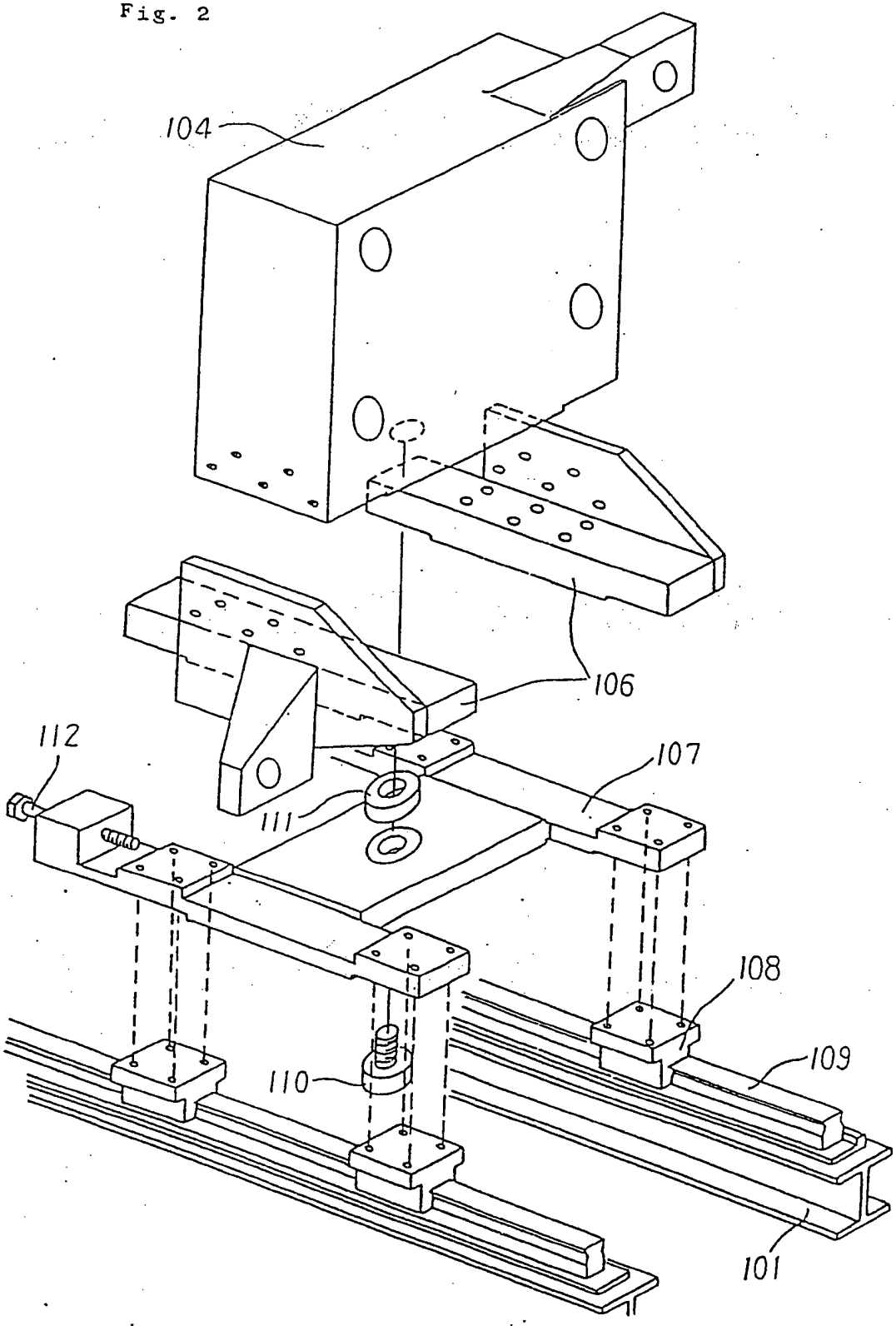

Fig. 3

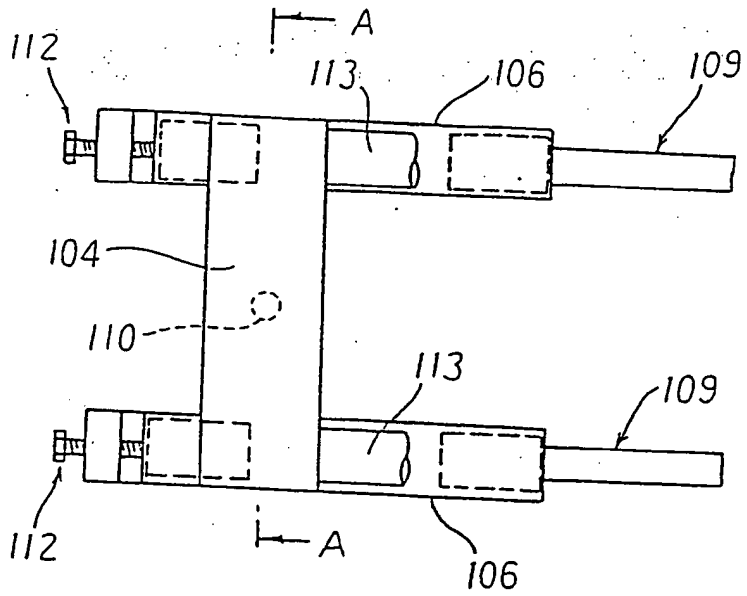
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Fig. 4

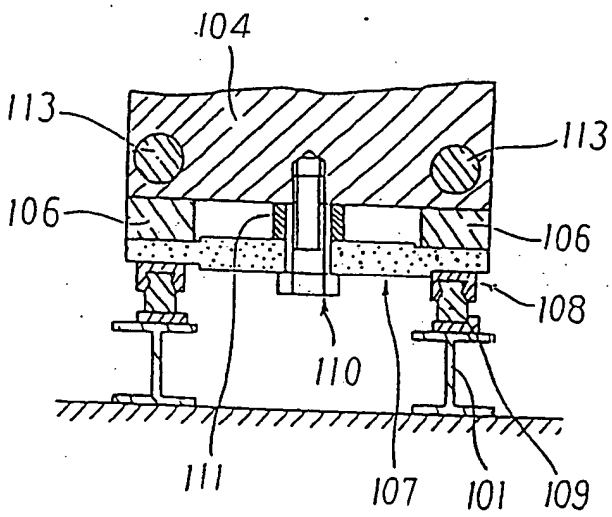
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Fig. 5

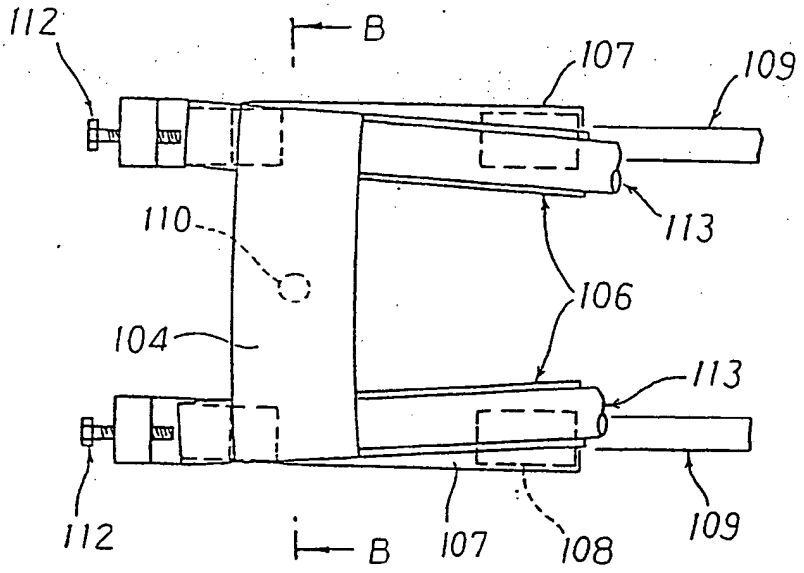
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Fig. 6

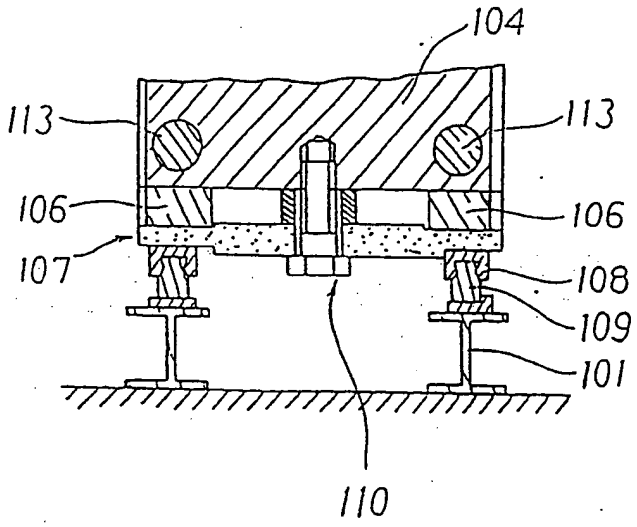
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Fig. 7

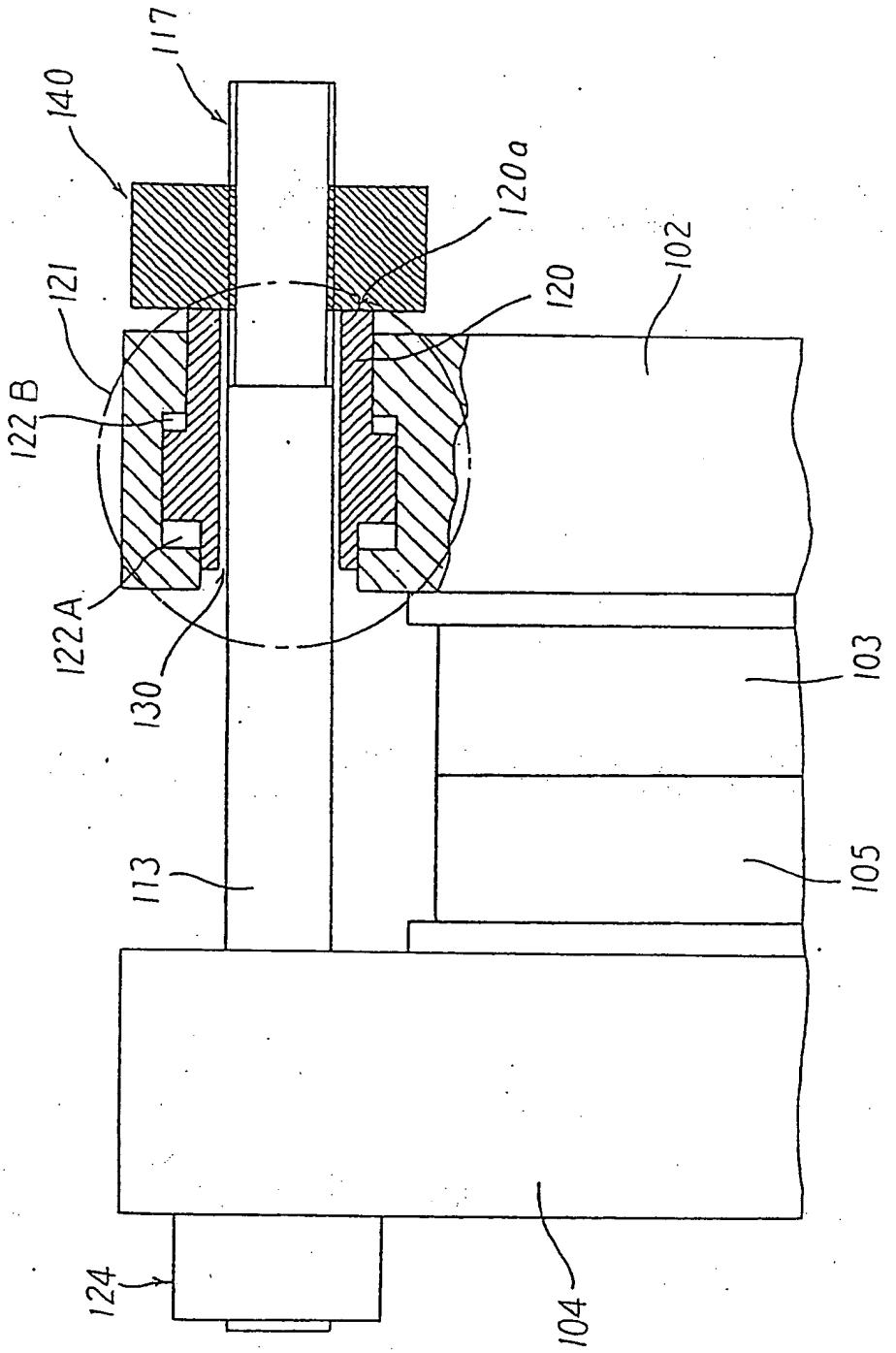

Fig. 8

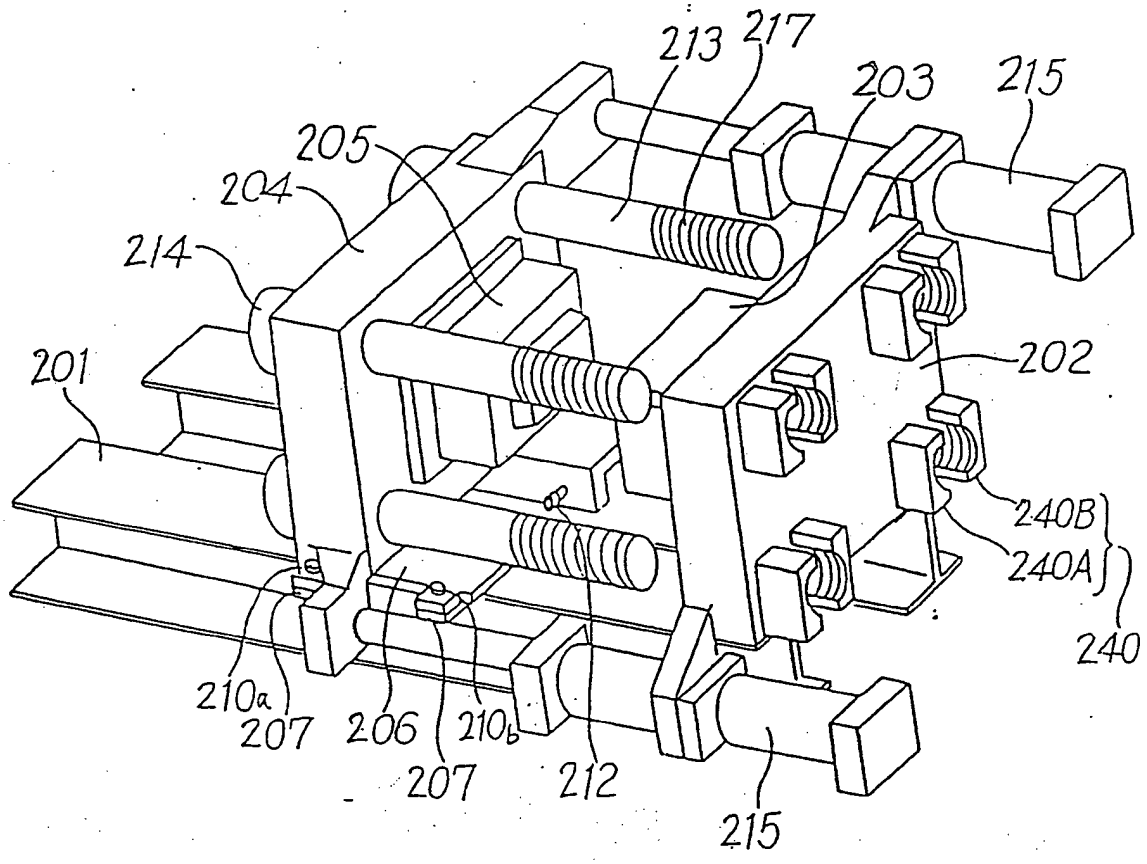
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Fig. 9

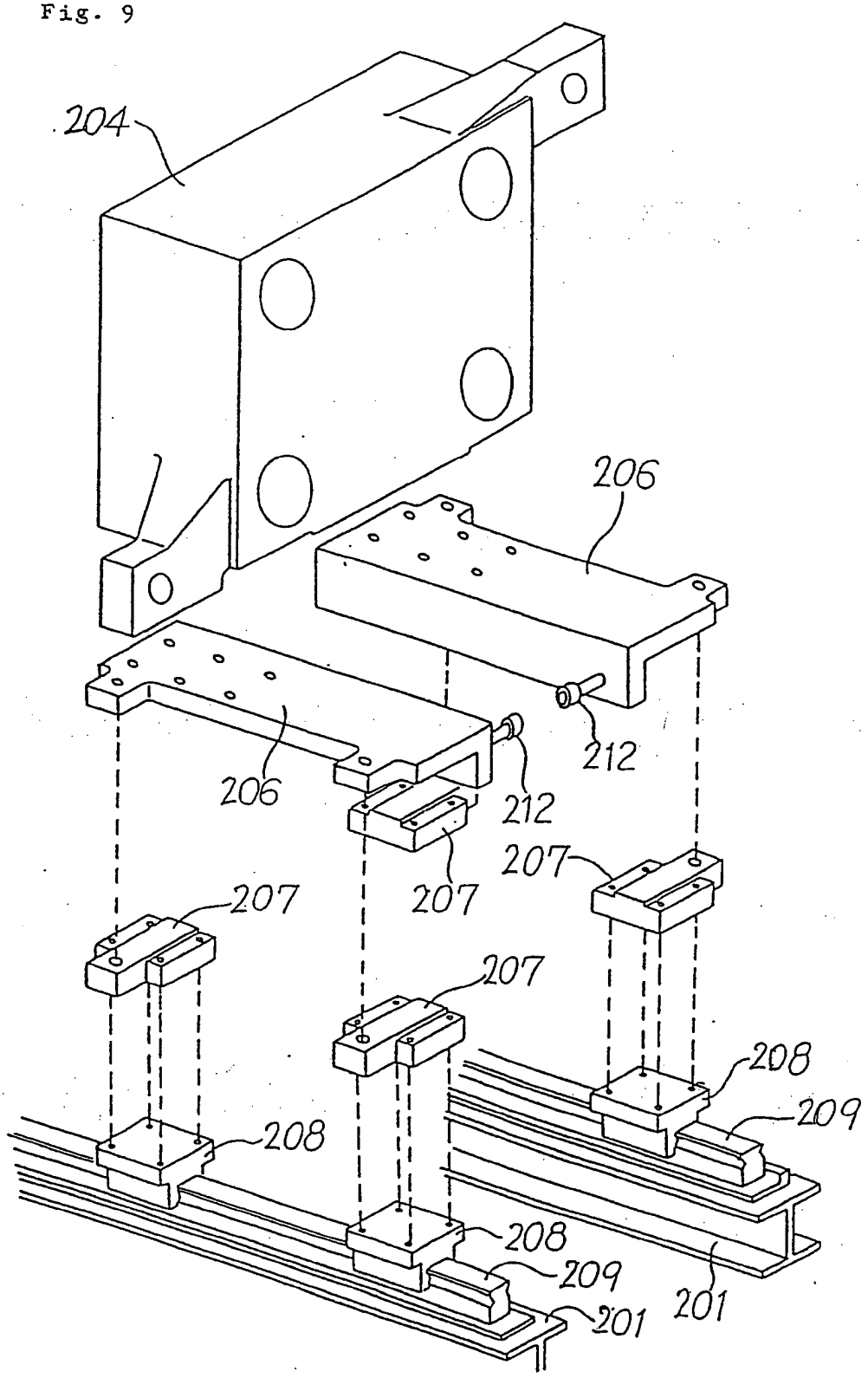

Fig. 10

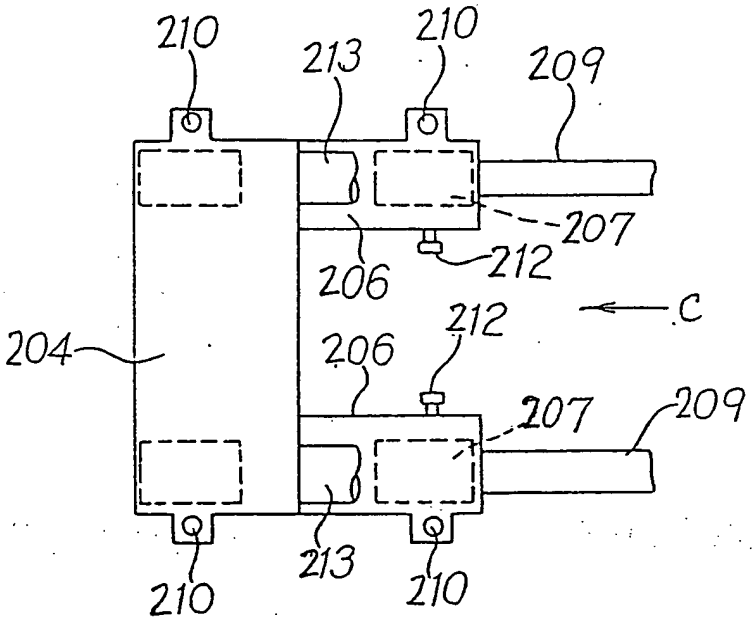
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Fig. 11

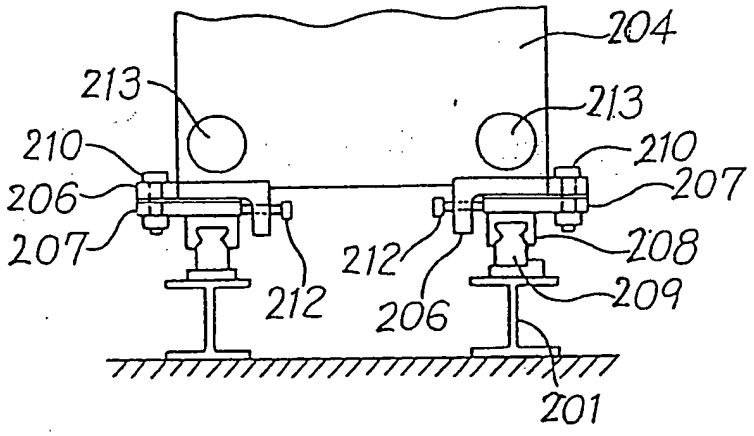
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Fig. 12

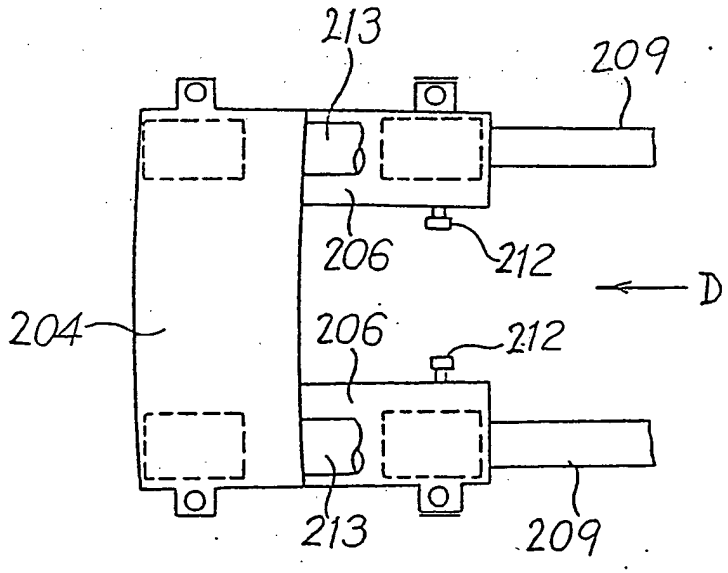
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Fig. 13

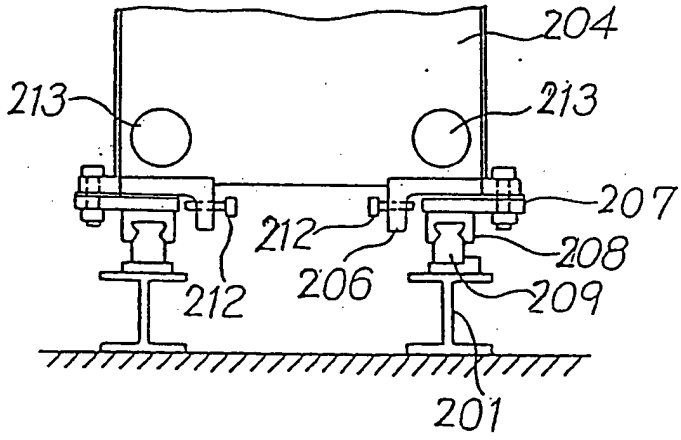
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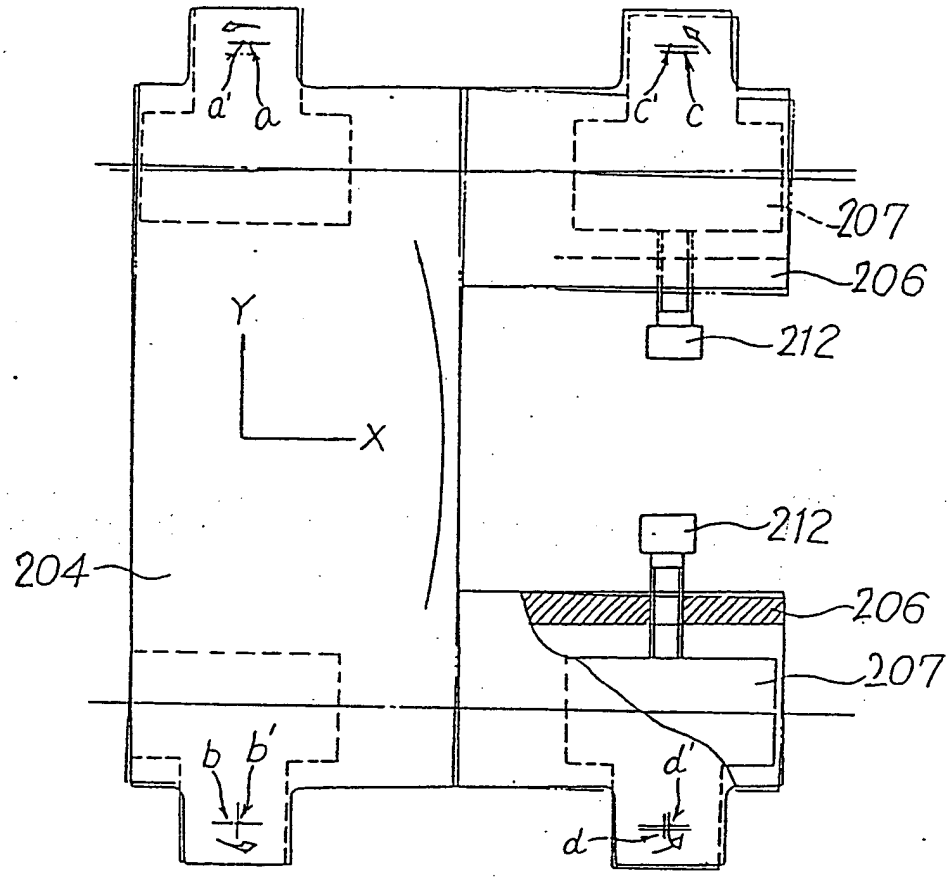
Fig. 14



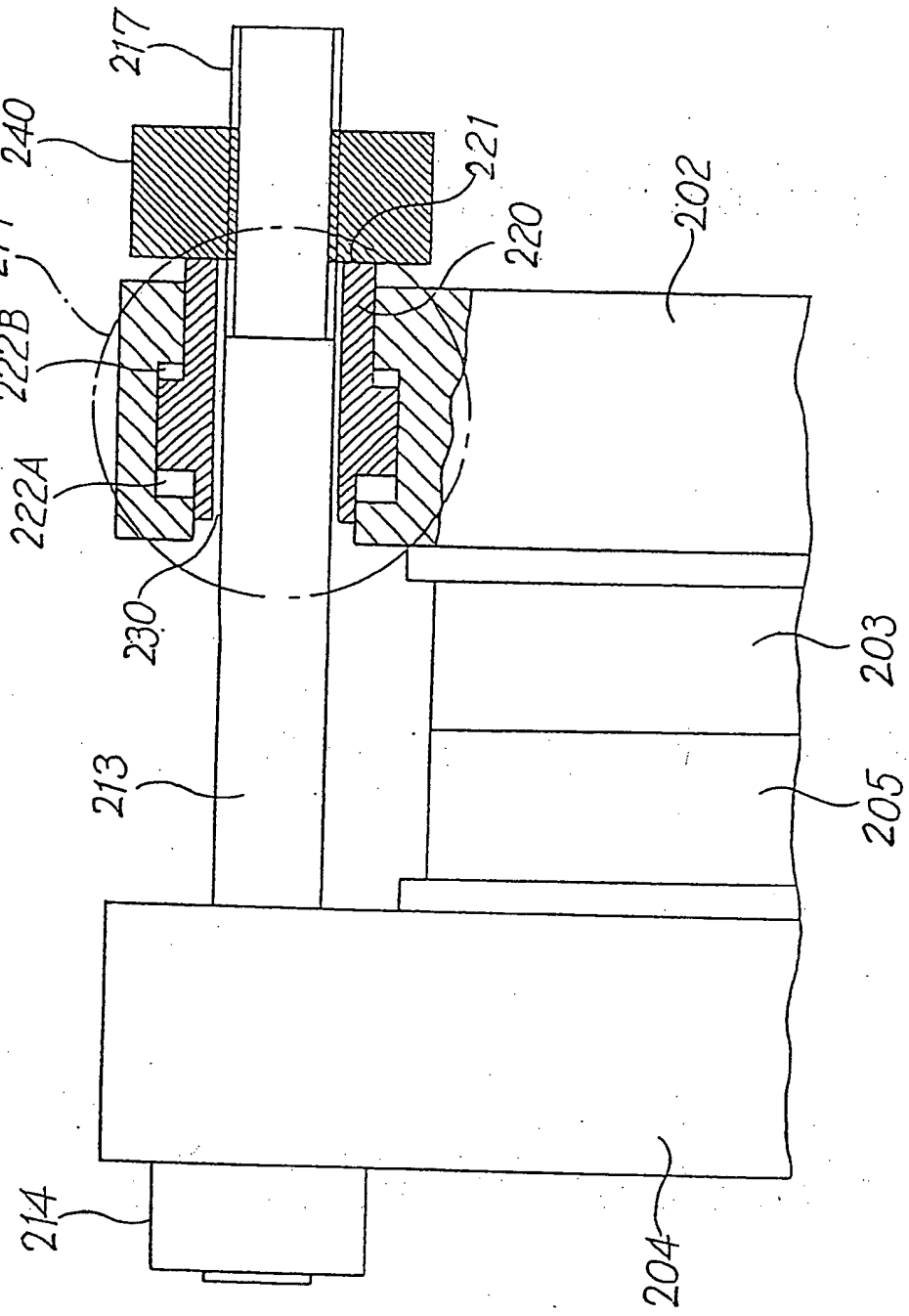


Fig. 15

Fig. 16 (Prior Art)

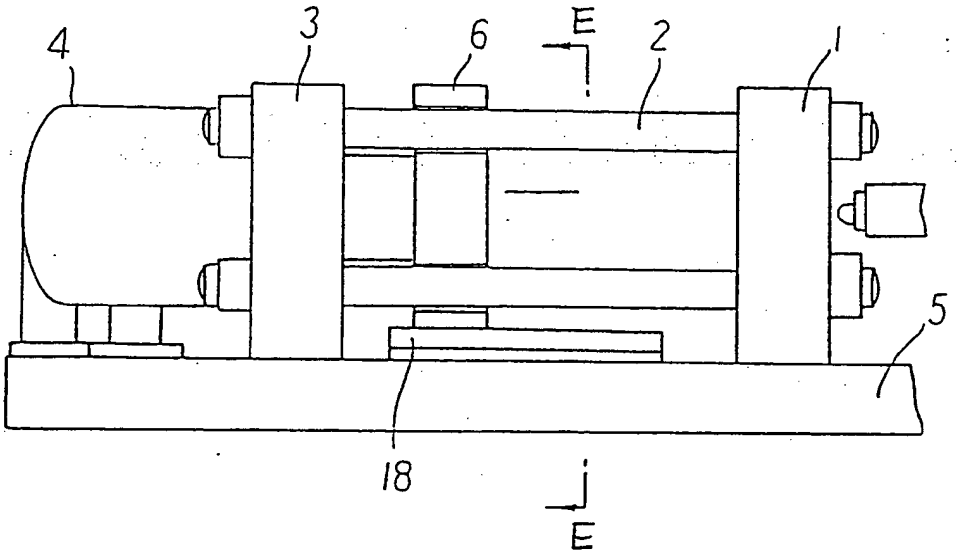


Fig. 17 (Prior Art)

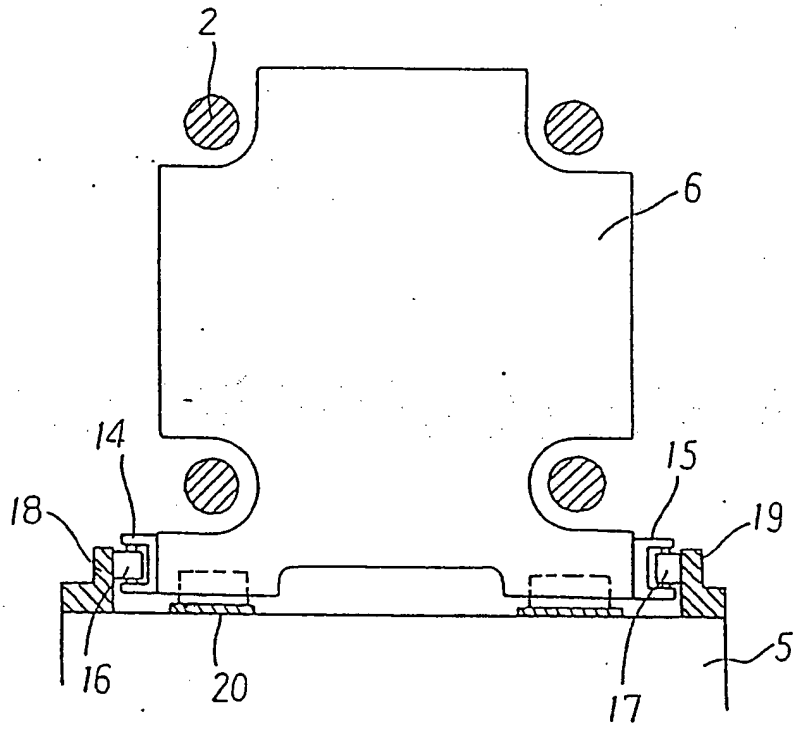


Fig. 18 (Prior Art)

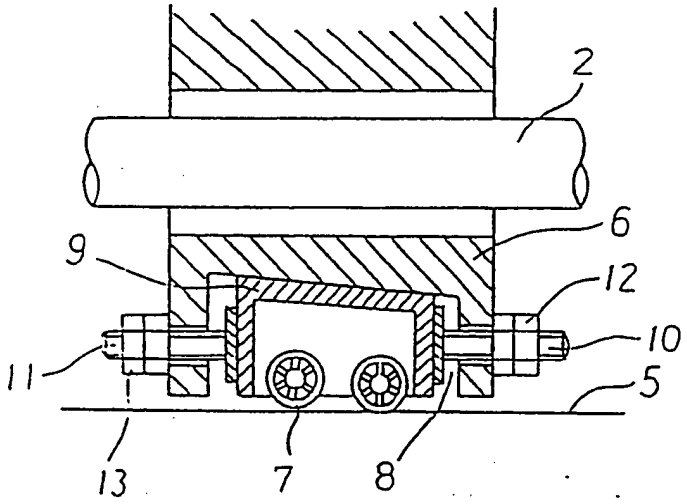
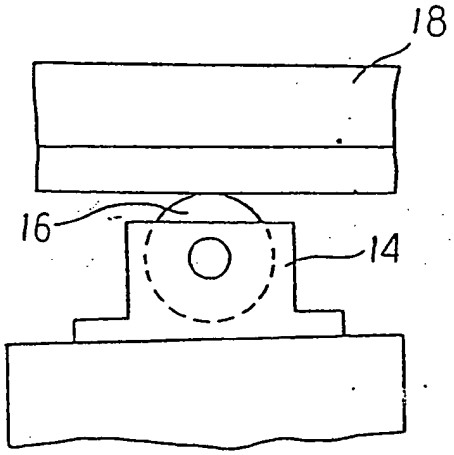


Fig. 19 (Prior Art)



European Patent Office

EUROPEAN SEARCH REPORT

Application number

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 88114069.9

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	DE - A1 - 3 215 567 (BATTENFELD) * Abstract; page 14, lines 9-13; fig. 1 * --	1	B 30 B 15/00 B 30 B 15/06 B 22 D 17/22 B 29 C 45/03
A	AT - B - 258 499 (VEB PLAST-MASCHINENWERK) * Fig. 1; claims 1,5 * --	1	
A	DE - B - 2 042 259 (MAHLE) * Fig. 1; claim * --	1	
A	FR - A1 - 2 425 321 (PONT-A-MOUSSON) * Fig. 1,5; claims 1,3 * ----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 30 B 15/00
B 30 B 9/00
B 22 D 17/00
B 29 C 43/00
B 29 C 45/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	31-01-1989	SCHÖNWÄLDER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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